Characterisation Of a Soil Catena on the Western Slope of The Piton Des Neiges Volcano (La Réunion)

Frédéric FEDER [a], Romain OLIVIER [a], Karine ALARY [b] and Gérard BOURGEON [c]

[a] CIRAD (French Agricultural Research Centre for International Development), "Environmental Risks of Recycling" research unit – station de la Bretagne, BP 20, F-97 408 SAINT-DENIS messagerie CEDEX 9, RÉUNION – FRANCE.
[b] CIRAD (French Agricultural Research Centre for International Development), "Analyses" support unit, TA 70/01 – Avenue Agropolis, F-34 398 MONTPELLIER CEDEX 5 – FRANCE.
[c] CIRAD (French Agricultural Research Centre for International Development), "Environmental Risks of Recycling" research unit – TA 70/01, avenue Agropolis, F-34 398 MONTPELLIER CEDEX 5 – FRANCE.

In La Réunion island, where only 17% (43 692 ha) of the total area is cultivated, a huge irrigation project aims at increasing the agricultural production on the western slope of the Piton des Neiges volcano. This needs a precise knowledge of the soil resource in order to optimise land use and to avoid environmental risks like erosion or groundwater pollution.
We started the updating of the existing soil map, prepared in 1988, by the detailed study of a soil catena at altitudes ranging between 350 and 1 950 m above mean sea level and annual rainfall (mean annual temperature) ranging from 800 mm (23°C) at the bottom to nearly 1700 mm (14°C) at the top. The Colimaçons experimental farm of CIRAD is located at 800 m on this catena.
The soils of the upper part of the catena (1 950 – 900 m) exhibit well developed andic properties. In the uppermost section of the sequence (1 950 – 1 400 m), under forests or heath, spodic horizons were identified and the soils were classified as Podzols. In old maps, these Podzols were often called “soils with Macareignite” because their albic horizon contains a large amount of biogenic opale. But, in fact, the second horizon has the required characteristics of a spodic horizon (particularly regarding the optical density of the oxalate extract).
Lower on the slope, between 1 400 and 900 m, dystric Andosols are found. Below 900 m elevation, andic properties gradually disappear and sugar cane becomes the main crop. From 900 to 350 m, the following succession of soils was identified: andic Cambisols (900 – 800m), Umbrisols (800 – 680 m), mollic Cambisols (680 – 600 m) followed by Phaeozems (600 – 450 m) and finally Nitisols (450 – 350 m).
In La Réunion, on the western slope of Le Piton des Neiges, nearly 70% of the arable land area have andic properties and the organic wastes (e.g. pig manure) are often applied on this type of soil, the monitoring of such a practice is undertaken at the Colimaçons farm.

Characterisation of a Soil Catena on the Western Slope of The Piton des Neiges Volcano (la Réunion)

Frédéric FEDER [a], Romain OLIVIER [a],
Karine ALARY [b] and Gérard BOURGEON [c]

[a] CIRAD, UPR Risque environnemental lié au recyclage, La Réunion, Saint-Denis, F-97 408 FRANCE.

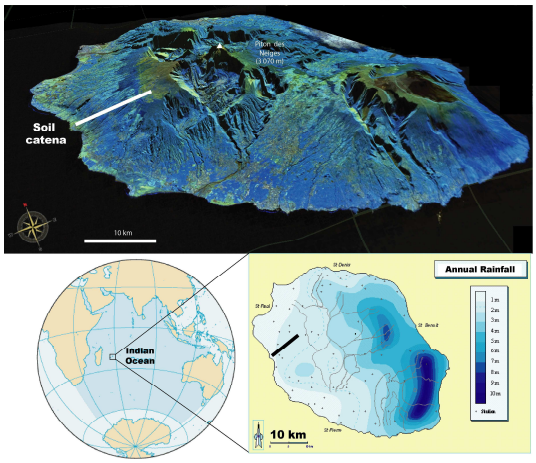
[b] CIRAD, US Analyses, Montpellier, F-34 398 FRANCE.

[c] CIRAD, UPR Risque environnemental lié au recyclage, Montpellier F-34 398 FRANCE.

Introduction

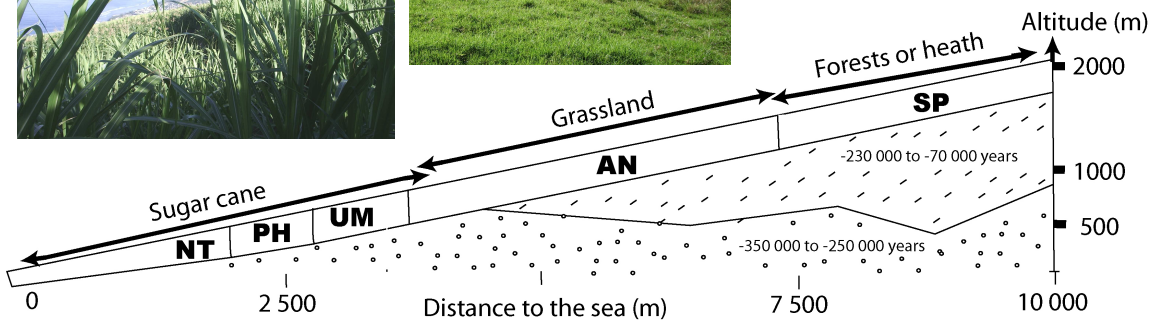
In la Réunion island, where only 17% (43 692 ha) of the total area is cultivated, a huge irrigation project aims at increasing the agricultural production on the western slope of the Piton des Neiges volcano. This needs a precise knowledge of the soil resource in order to optimise land use and to avoid environmental risks like erosion or groundwater pollution.

The studied soil catena stretches over 10 km between 350 and 1950 m above mean sea level, and is characterized by a climatic gradient with an annual rainfall (resp. mean annual temperature) ranging from 800 mm (23°C) to nearly 1700 mm (14°C).



Results and discussion

The soils of the upper part of the catena (1 950 – 900 m) exhibit well developed andic properties. In the uppermost section of the sequence (1 950 – 1 400 m), under forests or heath, superficial Podzols (SP) develop on Andosols (AN) and their deep horizons (e.g. at 80 cm depth, table) still exhibit andic properties. Lower on the slope, between 1400 and 900 m, dystric Andosols are found. Below 900 m elevation, andic properties gradually disappear and sugar cane becomes the main crop.



		NITISOLS	PHAEOZEMS	UMBRISOLS	ANDOSOLS	PODZOLS
	bulk density	1.2	1.2	1	0.8	-
	P retention (%)	31	45	62	93	65
	Saturation rate (%)	82	67	40	8	5
5 cm	CDB ext. Fe (g.kg^{-1})	44	90	92	96	34
depth	CDB ext. Al (g.kg^{-1})	6	13	24	50	9
	Oxal. ext. Fe (g.kg^{-1})	7	9	14	39	23
	Oxal. ext. Al (g.kg^{-1})	9	9	14	54	13
	Oxal. ext. Si (g.kg^{-1})	3	3	4	14	3
	bulk density	1.3	1.3	1	0.5	-
	P retention (%)	34	53	76	96	77
	Saturation rate (%)	78	69	37	2	3
40 cm	CDB ext. Fe (g.kg^{-1})	37	78	92	138	51
depth	CDB ext. Al (g.kg^{-1})	8	12	20	55	10
	Oxal. ext. Fe (g.kg^{-1})	9	9	12	69	37
	Oxal. ext. Al (g.kg^{-1})	19	12	10	57	12
	Oxal. ext. Si (g.kg^{-1})	8	4	4	13	2
	bulk density		1.35	1	0.5	0.8
	P retention (%)		57	72	96	94
	Saturation rate (%)		74	37	3	1
80 cm	CDB ext. Fe (g.kg^{-1})		66	96	90	112
depth	CDB ext. Al (g.kg^{-1})		11	23	48	55
	Oxal. ext. Fe (g.kg^{-1})		7	12	36	45
	Oxal. ext. Al (g.kg^{-1})		13	15	58	56
	Oxal. ext. Si (g.kg^{-1})		4	5	19	25

From 900 to 350 m, the following succession of soils was identified:
900 – 800 m: andic Cambisols (not shown),
800 – 680 m: Umbrisols (UM),
680 – 600 m: mollic Cambisols (not shown),
600 – 450 m: Phaeozems (PH)
450 – 350 m: Nitisols (NT).

Conclusions and perspectives

A great diversity of soil types was enlightened by our study and their distribution along the slope follows the climatic gradient. The study of the behaviour of these soils under new land management practices (irrigation combined with heavy application of organic manure) will constitute the second phase of our research.

Acknowledgements
This work was conducted with funding support from FEOGA, the Region and the Département de La Réunion.

CIRAD

Centre de coopération international en recherche agronomique pour le développement